

Range Sustainment: Assessing Marine Corps Operational Small Arms Ranges (SARs)

May 6, 2009

*Alicia Fogg
Malcolm Pirnie, Inc.*



Solutions for Life™

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 06 MAY 2009		2. REPORT TYPE		3. DATES COVERED 00-00-2009 to 00-00-2009	
4. TITLE AND SUBTITLE Range Sustainment: Assessing Marine Corps Operational Small Arms Ranges (SARs)				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Malcolm Pirnie, Inc, 211 N. Florence St, Suite 202, El Paso, TX				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Presented at the NDIA Environment, Energy Security & Sustainability (E2S2) Symposium & Exhibition held 4-7 May 2009 in Denver, CO. U.S. Government or Federal Rights License					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 34	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Presentation Outline

- Introduction to the REVA Program
- SAR Protocol Development
- SAR Protocol
- Case Study
- Lessons Learned



Presentation Outline

- ***Introduction to the REVA Program***
- SAR Protocol Development
- SAR Protocol
- Case Study
- Lessons Learned



Range Environment Vulnerability Program (REVA)

- Marine Corps' methodology for assessing off-range environmental impacts from its operational training ranges
- DoD Instruction 4715.14:
 - Determine whether a release or substantial threat of a release of munitions constituents (historical and current) from an operational range poses an unacceptable risk to human health or the environment
 - Identify management practices to maintain (or increase) capacity and/or capability of the operational range
- Re-assess operational ranges on 5-year cycles



REVA Process



- Installation site visit and data collection
- Baseline environmental range assessment and fate and transport modeling
 - Primary (Indicator) MCs:
 - TNT, RDX, HMX, perchlorate, lead
- Environmental sampling (as appropriate)
- REVA report and recommendations
 - Establish baseline environmental range conditions
 - Range BMPs
 - CERCLA response (if demonstrated off-range release)



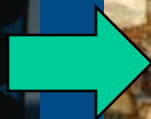
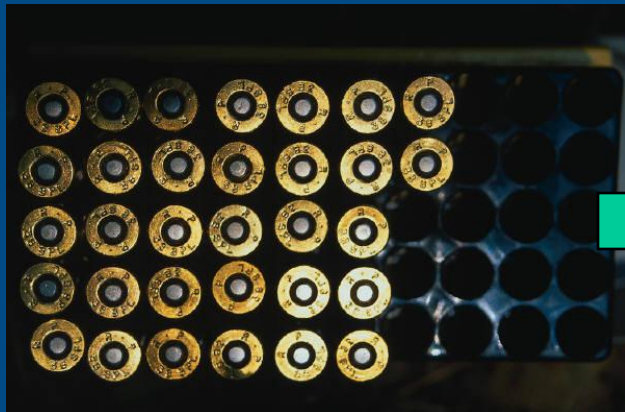
Presentation Outline

- Introduction to the REVA Program
- ***SAR Protocol Development***
- SAR Protocol
- Case Study
- Lessons Learned



Small Arms Range Assessment Protocol

- REVA Munitions Constituent (MC) Indicator compound is lead
- Lead is the most prevalent potentially hazardous compound in Small Arms Ammunition (by weight)
- Fate and transport of lead based entirely on site-specific geochemical parameters



Factors Affecting Lead Migration

pH of Water

Quantity of lead

Depth to
Groundwater

Slope

Precipitation

Vegetation

% Organic Material

pH of Soil

Maintenance

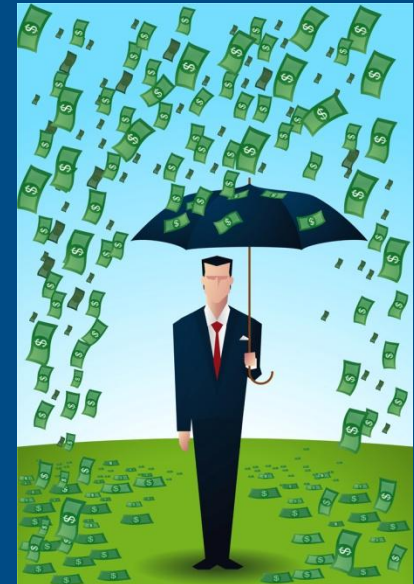
Soil Type

One factor is not necessarily more important
than the other factors



Qualitative vs. Quantitative Assessment

- 100's of active SARs across the Marine Corps installations
- 100's site-specific geochemical samples would be required to quantitatively assess (model) all SARs
- Methodology to **prioritize** ranges based on factors affecting potential lead migration
 - Range Use and Design
 - Environmental and Physical Conditions
 - Location of Potential Receptors



Presentation Outline

- Introduction to the REVA Program
- SAR Protocol Development
- ***SAR Protocol***
- Case Study
- Lessons Learned



SAR Protocol

- Purpose: **prioritize** SARs qualitatively to determine which ranges should be address quantitatively
- Each Criteria given numerical rating based on potential to affect lead migration (range from 1 to 5)
1 = low potential 3 = medium potential 5 = high potential
- Broken out into 7 tables
 - Range Use (Table 1)
 - Surface Water and Groundwater Pathways (Tables 2 and 3)
 - Surface Water and Groundwater Receptors (Tables 4 and 5)
 - Environmental Evaluation (Table 6)
 - Guidelines for Recommendations (Table 7)



Table 1 – Range Use and Range Management

Table 1: Range Use and Range Management (Source) Element (These definitions only apply for the purposes of the Assessment Protocol.)			
Criteria	Evaluation Characteristics	Score Criteria	Site Score
Duration of Range Use	Length of time the range has been used	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	
Bullet-Capturing Technology	The presence and duration of bullet-capturing technologies. Compare the duration of the range use to the duration of bullet-capturing technologies.	If [range usage duration = bullet capture duration], then apply a negative score so that the [range usage duration + bullet capture duration] = 1 If [range usage duration – bullet capture duration] = 10 to 30 years, then apply a negative score so that the [range use duration + bullet capture duration] = 3 0 if [range usage duration – bullet capture duration] > 30 years	
MC Loading Rates	The amount and types of small arms ammunition expended on the range. Estimate the MC loading by using a time weighted average of MC loading rates	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	
Range Maintenance	Frequency of any range maintenance activities involving the removal of lead from the ranges	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	
Source Element Score			
Notes:			



Table 1 – Range Use and Range Management

Table 1: Range Use and Range Management (Source) Element

Criteria	Evaluation Characteristics	Score Criteria	Site Score
Duration of Range Use	Length of time the range has been used	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	
Bullet-Capturing Technology	The presence and duration of bullet-capturing technologies Compare the duration of the range use to the duration of bullet-capturing technologies.	If [range usage duration – bullet capture duration], then apply a negative score so that the [range usage duration + bullet capture duration] = 1 If [range usage duration – bullet capture duration] = 10 to 30 years, then apply a negative score so that the [range use duration + bullet capture duration] = 3 0 if [range usage duration – bullet capture duration] > 30 years	
MC Loading Rates	The amount and types of small arms ammunition expended on the rangeEstimate the MC loading by using a time weighted average of MC loading rates	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	
Range Maintenance	Frequency of any range maintenance activities involving the removal of lead from the ranges	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	
Source Element Score			
Notes			

Duration of Use:

Usage < 10 yrs = 1 pt

Usage >10 yrs but <30 yrs = 3 pts

Usage > 30 yrs = 5 pts



Table 1 – Range Use and Range Management Criteria

- Duration of Range Use
- Bullet Capture Technology
 - Reduce Range Use Score with bullet capture technology
- MC/Lead Loading Rates: based on lbs lead/yr
- Range Maintenance

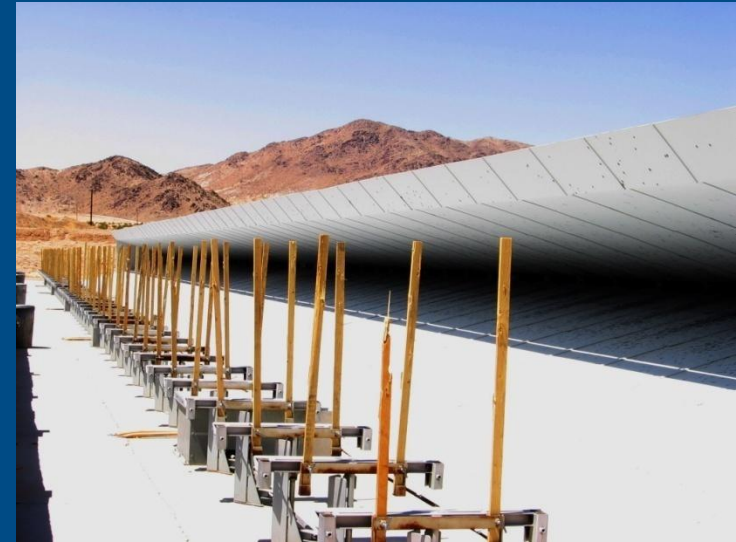


Table 2/3 – Surface Water and Groundwater Pathway Characteristics Criteria

- pH of Water/Soil
- Precipitation
- Slope of Range
- Vegetation
- Soil Type /Runoff Conditions
- Runoff Erosion Engineering Controls
 - Reduce Overall Score if Current Engineering Control are in place



Table 4/5 – Surface Water or Groundwater Receptors Criteria

Purpose: to identify potential off-range receptors

- Drinking Water Usage
- Agricultural or Other Beneficial Usage
 - E.g. Recreational Use
- Threatened or Endangered Species Habitat



Table 6 – Relative Environmental Concern

- Sum all the scores of Surface Water pathway (Tables 1, 2, and 4) and Groundwater pathway (Tables 1, 3, and 5)

Table 6: Relative Environmental Concern Evaluation		
Surface Water		
Element	Table	Score
Range Use and Range Management (Source)	1	
Surface Water Pathways	2	
Surface Water Receptors	4	
Sum of Surface Water Element Scores		
Groundwater		
Element	Table	Score
Range Use and Range Management (Source)	1	
Groundwater Pathways	3	
Groundwater Receptors	5	
Sum of Groundwater Element Scores		



Potential Data Sources

- Installation Reports (MMRP, IRP, ISR, Master Plans etc.)
- Range Standard Operating Procedures
- RFMSS or other range loading data
- Archive Search Reports
- U.S. Geological Survey Data and Reports
- U.S. Department of Agriculture
- Aerial Photographs



Presentation Outline

- Introduction to the REVA Program
- SAR Protocol Development
- SAR Protocol
- ***Case Study*** →
 - 4 Ranges
 - 4 Installation
 - 3 Climates
- Lessons Learned



Range 1: Desert Environment

(with off-site receptors)

- Known Distance Pistol Range
- No bullet trap present or other capture technology
- Currently 101 lbs lead per year
- Little to no vegetation (creosote bushes)
- Low precipitation rates
- Gravelly sand



Range 2: Desert Environment

(no off-site receptors)

- Known Distance Rifle Range
- No bullet trap present or other capture technology
- Between 4,700 to 8,000 lbs of lead per year
- Little to no vegetation (creosote bushes)
- Low precipitation rates
- Sands and gravels



Range 3: Temperate Environment

- Known Distance Pistol Range
- Bullet Trap in Place
- Between 1,200 to 1,500 lbs of lead per year
- Grasses, shrubs and trees
- High precipitation rates
- Sandy clay
- Very acidic soils



Range 4: Tropical Environment

- Known Distance Rifle Range
- No Bullet Capture Technology in place
- Approximately 3,300 lbs of lead per year
- Eroded bullet pockets, with grass surrounding
- Moderate precipitation rates
- Clay or Rock



Table 1: Range Use and Range Management

Criteria	Range 1	Range 2	Range 3	Range 4
Duration of Range Use	5	5	5	5
Bullet-Capture Technology	0	0	0	0
MC (lead) Loading Rates	3	5	5	5
Range Maintenance	5	5	5	5
	13	15	15	15

- As long as lead loading greater than 1,000 lbs per year, range receives score of 5 (most ranges assessed)
- Few differences between ranges in Table 1
- Few Ranges with continual maintenance (> once/five years)



Table 2: Surface Water Pathways Characteristics

Criteria	Range 1	Range 2	Range 3	Range 4
pH of Water	1	1	1-3	1
Precipitation	1	1	5	3
Slope of Range	5	5	5	5
Vegetation	5	5	1	3
Soil Type/Runoff Conditions	1	1	3	5
Runoff/Erosion Control	-5	-5	-10	0
	8	8	5-7	17

- Erosion Control and run-on/run-off control is an important criteria
- Vegetation has significant impact on score
- pH of water is generally not significant



Table 3: Groundwater Pathways Characteristics

Criteria	Range 1	Range 2	Range 3	Range 4
Depth to Groundwater	1	0	3	3
Precipitation	1	1	5	3
pH of Water	1	1	1-5	1-5
pH of Soil	1	1	5	1
Soil Type/ Infiltration	5	5	3	1
Clay Content in Soil	5	5	3	1
	14	13	20-24	10-14

- No methodology to decrease rating at ranges with best management practices in place (bullet-traps)
- Depth to groundwater in desert climates is significant on score
- Soil type is double counted in this table
- Acidic soil and groundwater plays important role



Table 4: Surface Water Receptors

Criteria	Range 1	Range 2	Range 3	Range 4
Drinking Water Usage	2	2	2	2
Agricultural or Other Beneficial Usage	1	1	3	1
Sensitive Species Habitat and Threatened or Endangered Species	5	1	5	5
	8	4	10	8

- Generally, no surface water drinking water sources located nearby
- No methodology to differentiate between ranges with potential off-range receptors and without potential off-range receptors



Table 5: Groundwater Receptors

Criteria	Range 1	Range 2	Range 3	Range 4
Wells Identified as Potable Water Sources	2	2	2	2
Wells Identified for Agricultural or Other Beneficial Usage	1	1	1	1
Sensitive Species Habitat and Threatened or Endangered Species	1	1	1	1
	4	4	4	4

- Few noted down-gradient receptors for groundwater
- Several ranges had sampling data from previous investigations (MMRP or IRP) to help determine if lead was an issue



Table 6: Relative Environmental Concern

Element	Range 1	Range 2	Range 3	Range 4
<i>Surface Water</i>				
Range Use (Table 1)	13	15	15	15
SW Pathway (Table 2)	8	2	5-7	17
SW Receptor (Table 4)	8	4	10	8
	29	27	30-32	40
<i>Groundwater</i>				
Range Use (Table 1)	13	15	15	15
SW Pathway (Table 3)	14	13	20-24	10-14
SW Receptor (Table 5)	4	4	4	4
	31*	32*	39-43	29-33

* - decreased ranking to minimal from moderate due to lack of potential groundwater receptors



Table 7: Best Management Practices

Ranking	Ranges	Recommended Action
High (50-65)		Action required. 1. Sample appropriate media (groundwater, surface water, and/or soil). 2. Implement BMPs.
Medium (30-50)	Range 4 SW [40] Range 3 GW [39-43] Range 3 SW [30-32] Range 4 GW [29-33]	1. Implement BMPs. 2. Consider sampling appropriate media (groundwater, surface water, and/or soil).
Minimal (0-29)	Range 4 GW [29-33] Range 1 SW [29], GW [31*] Range 2 SW [27], GW [32*]	1. No further action needed. 2. Consider implementing BMPs.

* - decreased ranking to minimal from moderate due to lack of potential groundwater receptors



Presentation Outline

- Introduction to the REVA Program
- SAR Protocol Development
- SAR Protocol
- Case Study
- ***Lessons Learned***



Lessons Learned

- Data from the installation, government agencies, public, and private sources are readily available to complete this qualitative assessment
- Tables are quick and easy to prepare
- Cost savings compared to sampling or modeling
- Climate/environment have an impact on the rankings (some professional judgment between installations is required)
- Determination of complete/incomplete pathways is important, but may not be reflect in the scoring



Acknowledgments

- Headquarters Marine Corps
 - Ms. Jennifer Simmons
- USMC Teaching and Education Command
 - Mr. Mike Caras
- USMC Installations



Questions



*Alicia Fogg
Malcolm Pirnie, Inc.
211 N. Florence St, Suite 202
El Paso, Texas
afogg@pirnie.com*

